REMARKS

Claims 1-14 of the present application have been rejected under 35 U.S.C. § 103 as being obvious in view of combinations of the prior art references Mistretta '486, Mistretta '856, Mills and Biswal et al. Applicant traverse these rejections because the references fail to teach or suggest the present invention when considered either separately or in combination.

The two Mistretta references are the most material prior art cited by the examiner, but the discussion below will demonstrate that the method disclosed and claimed in the present application is substantially different. Please note that one of the applicants in this application is also a co-inventor named on the Mistretta et al patents. The present invention was made in the same laboratory and is believed to be a substantial improvement over the earlier work embodied in the two Mistretta et al references.

As indicated in paragraph [0008] of the present application under the heading "Background Of The Invention," it is common practice in contrast enhanced MRA ("CEMRA") to acquire a mask image before injecting contrast agent and before acquiring the contrast enhanced image. After the scan the mask image is subtracted from the contrast enhanced image so that the stationary tissues surrounding the blood vessels are nulled in the final MRA image. This subtraction presents some challenges if there is subject movement and it reduces the SNR of the MRA image.

The present invention is a method for producing a CEMRA image without the need for acquiring and subtracting a traditional pre-contrast mask. The Mistretta et al '856 patent employs a number of steps very similar to steps recited in the present application, but the method disclosed is very different and it accomplishes a very different objective. More particularly, the steps carried out in the Mistretta et al '856 reference is for the purpose of "vessel segmentation." That is, it is used to distinguish between signals produced by arteries and signals produced by veins. For diagnostic purposes it is most desirable to see the arteries and suppress venous signals which can confuse the MRA image. The Mistretta et al '856 patent describes how to do this.

However, this prior art reference still produces a precontrast image and subtracts that image in order to suppress the signal from surrounding stationary tissues. This is discussed at column 7, lines 45-56 in the '856 patent (see also Column 10, lines 38-47).

The Mistretta et al '486 patent is very similar to the '856 patent but it describes a method for suppressing the signals from stationary tissues that does not require subtraction of a pre-contrast mask image. More specifically, the method disclosed identifies image pixels that produce NMR signals indicating arterial blood flow and it identifies image pixels that produce NMR signals indicating venous blood flow. By process of elimination the remaining image pixels are presumed to be stationary "background" tissues and binary masks can be produced accordingly (column 11, lines 50-55). The limitations of this method are discussed in the present application at paragraph [0049].

The Biswal et al and Mills references are not material to the patentability of the present invention. Applicants cannot find any disclosure in Mills that relates to the present invention. The matrices and inversions of matrices discussed in Mills pertains to basic image reconstruction. It has nothing to do with modeling the time course signal of arterial spins, venous spins or undesired spin signals. Similarly, Biswal et al relate to fMRI, not CEMRA. The reference voxel vector referred to therein is a model of a task or stimulation of the subject which is designed to activate parts of the brain. It is a known piece of information based on the experiment being conducted and it is used to detect pixels in the brain image that appear to be responding to the stimulation or are active during a task. It is not derived from the acquired MR data.

The present invention does not require arterial and venous segmentation steps in order to produce a background mask. Instead, as recited in step d) of claim 1 an image "orthogonality image" is produced that indicates pixel signals that are "orthogonal to a model time course voxel vector" and this is used to remove background tissue signals without the need for a subtraction of a pre-contrast mask image. As discussed in paragraphs [0050] and [0051] the undesired signals are modeled (i.e., not the vascular signals as in the earlier Mistretta et al references) and the orthogonal complement is calculated to indicate how pixels that are not undesirable behave. So, the mask

produced from the resulting orthogonality image will remove undesirable signals without subtraction. Dependent claims 3 and 4 more specifically recite this step of the method. Claims 1-10 are, therefore believed to patentably distinguish over the prior art.

Independent claim 10 is similarly distinguished from the prior art. Step d) calls for producing a model time course voxel vector which is indicative of undesired tissues and using it to suppress undesired signals as recited in step e). The specifics which employ the orthogonal complement matrix is recited in claim 11. Unlike the prior art, the claimed invention models undesired signals and uses that model to remove those signals from the final image. Claims 10-14 are believed to recite patentable subject matter and allowance is requested.

Favorable reconsideration and allowance of this application is respectfully requested.

The Commissioner is authorized to charge any fees under 37 CFR § 1.17 that may be due on this application to Deposit Account 17-0055. The Commissioner is also authorized to treat this amendment and any future reply in this matter requiring a petition for an extension of time as incorporating a petition for extension of time for the appropriate length of time as provided by 37 CFR § 136(a)(3).

Respectfully submitted,

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